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**Via e-mail and ECFS**

Mr. Scot Stone
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October 22, 2019

**Follow-up letter to your original inquiry (e-mail) dated June 08, 2018,**
**Regarding monitoring/transparency of our PACTOR 3/4 communications modes**

by Hans-Peter Helfert, DL6MAA,
c/o Spezielle Communications Systeme GmbH & Co. KG, Germany

Dear Mr. Stone,

As additional information to your inquiry regarding PACTOR 3 and PACTOR 4 transparency, dated June 08, 2018, I would like to inform you that there are new, very simple and cost-effective ways to monitor PACTOR transmissions, and even LZHUF[1] compression used by Winlink, BPQ, PAT and others. This software called "PMON for Raspberry Pi[2]" is now freely available, see also our press release attached to this letter. Meanwhile, there are other solutions to decode LZHUF-compressed monitoring data, even developed by amateurs.

These developments underline once again that allegations of "effective encryption" of PACTOR transmissions, in particular asserted by Prof. Theodore Rappaport and the attorneys of NYU, are completely baseless. PACTOR 3 and PACTOR 4 are sufficiently documented within the scope of the legal requirements, and now there even is a free monitoring software for everyone available (currently for PACTOR 1-3, PACTOR 4 will follow soon). The cost of purchasing a PACTOR modem can no longer be presented as a hurdle for monitoring!

In addition, this new “PMON for Raspberry Pi” software also decodes LZHUF compressed data (i.e. compression not performed by the modem itself but through the application software, such as Winlink) as soon as a corresponding "B2F header" is recognized in the

[1] Source Code, lzhuf.c: https://github.com/keendreams/keen/blob/master/lzhuf.c
[2] PMON for Raspberry Pi: https://www.scs-ptc.com/en/PMON.html

receive data. The software offers combined PACTOR monitoring and LZHUF on-the-fly decompression.

As pointed out in our commentary[3] on Prof. Rappaport's comment on RM-11831, all our PACTOR modems have always included a comprehensive monitoring mode. I can only reiterate this once again and underline that “open speech” was one of the fundamental goals, when designing the PACTOR protocols, even though Dr. Rappaport's vague and inaccurate claims suggest the opposite.

However, the monitoring mode of our modems itself does not contain any methods for decompression on the application layer (LZHUF decompression). In this case, when using a modem as monitoring device, decompression must be done externally by means of additional software. So, for successful Winlink monitoring using an SCS modem, you have to apply such additional LZHUF decompression software. Here again, now there is a free solution offered by SCS to read Winlink data "on the fly" using a modem. This software is called PMON_lzh.exe[4].

Even a hobby programmer was able to develop an LZHUF decoder within days, using C programming language and parsing the PMON raw (LZHUF compressed) data generated by PACTOR modems working in monitoring mode, see publications by Gordon Gibby[5] , MD.

This also works perfect for PACTOR 4.

I would like to briefly explain the technical background of application and transport layers again:

The monitoring device can only read the data that the application software has sent to the modems involved to the transport over the shortwave channel.

At this point, it is important to distinguish very accurately between the actual transport method (the means of transporting the bytes over the shortwave channel, e.g. PACTOR, Winmor, ARDOP, etc.) and the application that generates that data. Nowadays, the application usually compresses the data before sending it over the shortwave channel; so it is also at Winlink. All e-mails are compressed by the Winlink software according to the B2F standard, which uses LZHUF as the actual compression method, i.e. the amount of data to be sent is reduced to the necessary size and the shortwave channel is thereby relieved. This has nothing to do with encryption or obfuscation, but only serves to reduce the amount of data; so it is a technological necessity - if Winlink or others want to keep to the state of the art.

[3] SCS reply on Dr. Rappaports comments on RM-11831:
https://ecfsapi.fcc.gov/file/10512224804129/SCS_FCC_Reply_RM11831.pdf
[4] PMON_lzh, version 1.07: https://www.p4dragon.com/download/pmon_lzh_v_1_0_7.zip
[5] Dr. Gordon Gibby, free LZHUF decoder software:
https://ecfsapi.fcc.gov/file/10830048730238/FreeSoftwareToReadWINLINK.pdf

Of course, this compression applied by the application software means that the actual text does not immediately appear when monitoring this data using an SCS modem. The receiving data must then first be decompressed before it actually can be read.

It is really hard to follow the arguments of the PACTOR / Winlink opponents:

We do not understand how to present the additional necessary step of decompression on the application layer as a defect or mistake or omission of a necessary thing on the modem side. The modem simply does not know what kind of data will be sent by the application. Here, the question of business-damaging and libel will have to be examined, because the situation is very clear, and the necessary facts and documents have been available for years on the SCS server for public access, in particular the description of PMON monitoring mode[6] of PACTOR modems.

The real "problem" that Dr. Rappaport apparently has is decompressing LZHUF-compressed data sent by Winlink and some other amateur radio applications (FBB, BPQ, D-RATS, etc.). But the problem is not real, as LZHUF was developed and documented in the 1980's and is a very popular dictionary compression, similar to well-known LZW compression. The B2F protocol, which serves as a wrapper for LZHUF compression in amateur radio, was described by Jean-Paul Roubelat more than 20 years ago and is still available as open source code on the Internet[7], as well as the source code for actual LZHUF compression[8] The compression method criticized by Dr. Rappaport is thus "open source" - and in no way proprietary or not freely available.

In contrast to many more modern compression methods, pure LZHUF as used by Winlink, even allows on-the-fly decompression, i.e. you do not have to receive the entire file without errors in order to be able to decode anything at all. The data only must be sent to the decoder from the beginning of the file - and after the first 60 input bytes, the corresponding decompressed output will appear! The decompression continues according to this pattern, after further quite short pieces of data are input, decompressed data appears again. This allows streamed real-time monitoring of the transmission of "file compressed" data! This is a very advantageous feature of the LZHUF method and thus it offers an excellent tradeoff between good, universal compression and ease of monitoring. The only real drawback is the lack of "late entry capability". Decoding will be performed properly until there is a gap in the input data stream. Missing data in the received data stream thus (with current technology) leads to an abort of decoding. However, this is not a true obstacle to reading LZHUF-compressed file transmissions. Reading is only a matter of SNR – and in the case of fading channels it can be improved to the desired extent by applying diversity reception or other advanced techniques. Such techniques would also be required of voice transmission monitoring if one wishes a 100 % monitor despite recurrent fading.

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[6] PMON monitoring mode on SCS DR-7X00 modems, User Manual: https://www.p4dragon.com/download/Update_Info_DR7X00_Version_1_17_English.pdf

[7] See 'documentation' for information on FBB LZHUF compressed forwarding: http://www.f6fbb.org/

[8] lzhuf.c: https://github.com/keendreams/keen/blob/master/lzhuf.c

In summary, I would like to stress again:

1. that ‘effective encryption’ is a disingenuous claim by Prof. Theodore Rappaport.

2. that compression is not encryption.

3. that the proof-of-concept development and testing by Dr. Gibby from the documentation of Jean-Paul Roubelat and the Winlink Team proves that the current rules are sufficient to develop tools and enable amateur radio self-policing.

4. that the current and correct criteria for prohibiting encoded messages is “intent to obscure meaning”, and

5. that the requirement for disclosure for the characteristics of a technique by publishing is correct and will survive future development, contrary to the solution proposed in RM-11831.

Respectfully,

Hans-Peter Helfert

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SCS
the pactor creators

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**PRESS RELEASE**

**For Immediate Release**

October 11, 2019

## PMON[1] - An Independent PACTOR / B2F Monitor for The Raspberry Pi

**SCS**, the company that created PACTOR, has released software for Linux to allow over-the-air monitoring for meaning of PACTOR 1/2/3 transmissions. The program requires only minimal hardware: an inexpensive Raspberry Pi 3 Model B+ (minimum) computer and an inexpensive USB sound device.

All **SCS** PACTOR hardware modems include a command that allows PACTOR monitoring on the fly. The PMON software now makes this possible without the use of a modem, and adds the ability to decode B2F/LZHUF compressed messages (Winlink and others) on the fly.

The program is a free download for radio amateurs from a Linux repository provided by **SCS**. Easy-to-follow instructions, program information and documentation are provided on this **SCS** web page: https://www.p4dragon.com/en/PMON.html

[1] NOTE: This exciting new software development for Raspberry Pi complements and surpasses previously released free **SCS** software that leveraged PACTOR modems' ability to monitor PACTOR to read Winlink for meaning. This new development allows monitoring of all kinds without even the hardware of the PACTOR modem.